TEXAS COMMISSION ON ENVIRONMENTAL QUALITY
Task 1: Clear Creek at Mykawa Street near Pearland, TX
CONTINUOUS WATER QUALITY MONITORING PROJECT PLAN

USGS Project No. 8653D2R

A1 APPROVAL PAGE

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A2 TABLE OF CONTENTS

Tables:

A2 LIST OF ACRONYMS

AQI	**Ambient Quality Invalid**
CVS	**Calibration Verification Sample**
CWQMN	Continuous Water Quality Monitoring Network
DO	**Dissolved Oxygen**
DM&QA	**Data Management and Quality Assurance**
EC	**Electrical Conductance (Reported as Specific Conductance)**
GOES	**Geostationary Operational Environmental Satellite**
LEADS	**Leading Environmental Analysis and Display System**
MOPs	**TCEQ Monitoring Operation Division**
MOQs	**Measurement Quality Objectives**
NA	**Not Applicable**
NIST	**National Institute of Standards and Technology**
QA	**Quality Assurance**
QAO	**Quality Assurance Officer**
QAPP	**Quality Assurance Project Plan**
QC	**Quality Control**
RPD	**Relative Percent Difference**
SC	**Specific Conductance**
SOP	**Standard Operating Procedure**
SWQM	**Surface Water Quality Monitoring Team**
SWQMIS	**Surface Water Quality Monitoring System**
TBD	**To Be Determined**
TCEQ	**Texas Commission on Environmental Quality**
TDS	**Total Dissolved Solids**
TRACS	**TCEQ Regulatory Activities and Compliance System**
RPE	**Relative Percent Error**
µS/cm	**micro Siemens per centimeter**
USGS	**U. S. Geological Survey**
WQM&A	**Water Quality Monitoring & Assessment Section**
YSI	**Yellow Springs Instrument**
°C	**Degrees Centigrade**

A3 DISTRIBUTION LIST

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY (TCEQ)

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Mr. David Brown, North Texas Program Office, USGS Texas Water Science Center
Mr. Wade Kress, San Angelo Hydrologic Surveillance & Analysis Unit, USGS Texas Water Science Center

A4 PROJECT/TASK ORGANIZATION

This section is intended to identify individuals and organizations that will be responsible for developing and/or supporting new CWQMN projects. This Project Plan describes policies, procedures, and protocols for the measurement of water quality by USGS at the site listed in Table A.4.3 of this project plan. For a list of additional project/task and responsibilities please refer to section A4 of the CWQMN QAPP.

A4.1 TCEQ CWQMN Network Coordinator: (Charles Dvorsky)

- Allocates adequate resources to ensure completion of the project in compliance with the stated objectives.
- Overall coordination of the Continuous Water Quality Monitoring Network (CWQMN) and primary contact.
- Describes the objectives for the CWQMN.
- Coordinates and facilitates development of site specific Data Quality Objectives (DQOs) or Measurement Quality Objectives (MQOs).
- Responsible for establishing new monitoring stations and integrating stations into the existing monitoring network.
- Provides project planning and prepares comments and project status reports.
- Ensures that QAPP requirements related to the activities within their tasks are met.
- Coordinates all document reviews.
- Facilitates CWQMN and Environmental Monitoring Response System (EMRS) team meetings.

A4.2 TCEQ Project Lead: (Christine Kolbe)

- Determined project objectives.
- Approves monitoring locations
- Responsible for obtaining, managing, and analyzing project data.

A4.3 TCEQ Contract Manager: (Ed Bridgman)

- Manage TCEQ/USGS contract amendment.

A4.4 CWQM Site Operator USGS Houston Program Office – Jeff East (713) 560-9618

Table A4.3 Site Operator: USGS Houston Program Office – Jeff East (713) 560-9618

TCEQ Region	Basin	CAMS Number	TCEQ Station ID	USGS Station ID	Operator	Site Location
12	San Jacinto-Brazos Coastal Basin	761	17077	08076997	USGS	Clear Creek at Mykaya St. near Pearland, TX

USGS will conduct operation of the instruments and site consistent with Standard Operating Procedure (SOP) AMPM-011, Analysis of Dissolved Oxygen (DO), Specific Conductance (SC), pH, Temperature, and Sample Depth in Ambient Surface Water Using Yellow Springs Instrument (YSI) 600 XLM and 6600 Extended Deployment System (EDS) Sonde (Attachment A) except for:

Method Summary 3.3

- The specific conductance sensor is a flow cell with four pure nickel electrodes for the measurement of solution conductance. Two of the electrodes are current driven and two are used to measure the voltage drop. The measured voltage drop is then converted into a conductance value. Specific conductance uses both the temperature and raw conductivity values associated with each determination to generate specific conductance value compensated to 25°C.

A4.4 Data Validation: USGS Houston Office (713) 560-9618

- Daily examination of data record to ensure completeness and accuracy of reporting.
- Maintenance of a hard copy validator log with notes sufficient to reconstruct a validation event at a later time.
- Investigation of loss data.
- Review of operator logs for post-calibration records and general site information.
- Communication with TCEQ Network Coordinator.
- Weekly validation of data record using Manual Validation.
- Monthly validation of hourly data.

A4.5 Project Participant

Project Technical Lead
Jeff East - USGS Houston Program Office **(713) 560-9618**

Project Technical Personnel
Michael Lee - USGS Houston Program Office (713 560-9614
Michael Burnich - USGS Houston Program Office (713) 560-9899

A5 PROBLEM DEFINITION/BACKGROUND

Clear Creek Above Tidal is a suburban freshwater stream located in the southernmost portion of the City of Houston, Texas. Water quality testing has found that concentrations of chlorides and total dissolved solids in Clear Creek Above Tidal (Segment 1102) are not optimum for supporting aquatic life.

The goal of this project is to support the reduction chloride and TDS in Clear Creek to levels that support a healthy aquatic community as identified in the TMDL Implementation Plan for Clear Creek (March 23, 2006) . This project will provide data to determine if the TMDL was

successful.

A6 PROJECT/TASK DESCRIPTION

Continuous monitoring of water temperature and specific conductance at the site listed in Table A4.3 beginning August 1, 2007 through August 31, 2008. USGS will host monitoring data from Table A4.3 locations on their continuous surface water monitoring web pages. TCEQ will decode the data from the NOAAPort and will ingest the data to LEADS. TCEQ will download the daily discharge look-up table for USGS and report the associated discharge for the site in LEADS.

A7 QUALITY OBJECTIVES AND CRITERIA

The measurement performance specifications to support the project objectives are specified in Table *A7.1*. Methods used are based on *Standard Methods for the Examination of Water and Wastewater*, 20th Edition, 1998 unless otherwise noted.

Table A7.1 – YSI 600XLM Performance Specifications

Parameter	Parameter Code	Units	Method	Calibration Verification Sample (CVS) *
SC	00094	µS/cm	Standard Method 2510	≤5.0% RPE
TDS	**00294**	mg/l	Calculated by LEADS. Sonde SC measurements are multiplied by 0.65.	≤5.0% RPE (SC CVS)
Temperature	00010	°C	Standard Method 2550 B	±1.5°C

* CVS criteria for use in the SWQM DQOs.

Ambient Water Reporting Limits (AWRLs)

Ambient Water Reporting Limits do not apply to this project.

Precision

Currently, sonde measurement precision is not being determined.

Bias

As described in section B5 of the CWQMN QAPP.

Representativeness

As described in section B5 of the CWQMN QAPP.

CWQM Comparability

As described in section B5 of the CWQMN QAPP.

CWQM Completeness

The minimum data completeness requirement for water quality is 75 percent valid data for each parameter (SC and Temperature). USGS validation requirements are outlined in Section D2 of this project plan. Periods of no flow or dry conditions necessitate shutdown of some instrumentation and these times are not considered in the goal for data completeness.

Data completeness is calculated as follows for stream sites:

$$\% \text{ Completeness} = \frac{\text{Number of valid measurements during Streamflow}}{\text{Total possible measurements} - \text{Total possible measurements during no Streamflow}} \times 100$$

A8 SPECIAL TRAINING/CERTIFICATION

According to the TCEQ *Quality Management Plan*, training requirements for contract staff shall be stated in contract specifications if contracted work is part of the project. In accordance with TCEQ agreement number 582-5-72628:

- Field operator training will be provided by designated TCEQ personnel to USGS personnel within 60 days of the final approval of this project plan.
- Manual data validation training will be provided by designated TCEQ personnel to USGS personnel. Manual data validation training occurred on May 23, 2007, for the following USGS personnel:

    - Michael Lee - USGS Houston Office (713 560-9614
    - Milton Sunvison - USGS Austin Field Office (512) 940-9393
    - Michael Canova - USGS Austin Field Office (512) 413-5537
    - Jon Snatic - USGS Austin Field Office (512) 423-2517
    - Cary Carman - USGS San Angelo Field Office (325) 280-1352
    - Amy Clark - USGS San Antonio Office (210) 827-0585
    - Chiquita Lopez - USGS San Antonio Office (210) 827-7122
    - Brian Petri - USGS San Antonio Office (210) 414-1285
    - Mick Baldys - USGS Fort Worth Office (817) 253-3470

A9 DOCUMENTS AND RECORDS

As described in section A9 of the CWQMN QAPP.

B1 SAMPLING PROCESS DESIGN

Site Selection Criteria

The TCEQ project lead chose monitoring locations that will provide the needed information for the project objectives in section A5 of this project plan.

The USGS has published a method for the operation of continuous water quality stations (USGS Techniques and Methods 1-D3, 2006). (http://pubs.usgs.gov/tm/2006/tm1D3). The USGS guidance document describes the site selection process and was followed to develop the procedures included in the above named SOP.

Monitoring Station Design

Monitoring and/or support equipment are installed in weather-tight aluminum enclosures or climate controlled trailers containing a data logger, modem, telemetry equipment, and various other support equipment.

Monitoring and support equipment:
YSI 600XLM
Sutron Satlink with display, 300 baud (HDR) radio.
Yagi antenna
20 watt arrays with charging regulator solar panel.

Site operation and maintenance will be provided by the site operator listed in Section A4.4.

B2 SAMPLING METHODS

In-situ water quality, sample depth, and water level measurements are logged once every 15 minutes by the data logger.

Table B2.1 – CWQMN - Monitoring Methods and Equipment

River Basin	Station Location	MetroStar/ LEADS Data Averaging Time	Sampling Method	Measurement Equipment	Telemetry	Station Parameters
San Jacinto-Brazos Coastal Basin	At Mykawa Street near Pearland, TX	Measurement every 15 minutes	YSI 600XL	YSI 600XL	GOES	Surface Temperature Surface SC

Sampling/Measurement System Corrective Action

USGS is responsible for Sampling/Measurement system corrective action. Corrective action measures in the CWQMN will be taken to ensure the DQOs and Measurement Quality Objectives (MQOs) are attained. The site operator is responsible for monitoring the performance of the measurement and

support equipment and identifying problems or potential problems. The site operator is responsible for documenting problems and corrective actions in the appropriate instrument logbook(s).

B3 SAMPLING HANDLING AND CUSTODY

See Section B10 of this project plan for electronic data management.

B4 ANALYTICAL METHODS

Analytical methods are listed in Table A.7.1 of this project plan.

B5 QUALITY CONTROL

As described in Section B5 of the CWQMN QAPP. Please see Table A7.1 for QC criteria. USGS will follow procedures and criteria in TCEQ SOP AMPM-011, Analysis of Dissolved Oxygen (DO), Specific Conductance (SC), pH, Temperature, and Sample Depth in Ambient Surface Water Using Yellow Springs Instrument (YSI) 600 XLM and 6600 Extended Deployment System (EDS) Sonde (Attachment A). See exceptions listed in section A4.3 of this project plan.

B6 INSTRUMENT/EQUIPMENT TESTING, INSPECTION AND MAINTENANCE

USGS maintenance documents are based on manufacturers' recommendations. Instrument maintenance activities are documented in equipment dedicated logbooks. Preventative maintenance records contain information on periodic routine maintenance, symptoms, troubleshooting effort descriptions, results and follow-up observations. Records should include the date, time, and the name or initials of the site operator performing the maintenance.

YSI Series 6 operational, maintenance and inspection manuals are being used as guidance for maintenance activities.

TCEQ AMPM-011 is the SOP being used for instrument testing by CVS requirements.

B7 INSTRUMENT CALIBRATION AND FREQUENCY

As described in TCEQ YSI SOP AMPM-011. See USGS exceptions listed in A.4.4

B8 INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

Standards, reagents and parts are purchased using USGS procurement guidelines. Standards and reagents are traceable to NIST standards. Certification of traceability is available upon request.

Site operators are required to keep replacement probes and instrument parts on hand at all times for field equipment.

B9 NON-DIRECT MEASUREMENTS

There are no non-direct measurements used for continuous water quality monitors.

B10 DATA MANAGEMENT

TCEQ Project Lead will be responsible for analyzing project data as described in section B10 of the CWQMN QAPP.

Monitoring site data are stored in a Sutron Satlink data logger and transmitted via GOES satellite to TCEQ (Austin, Texas) Comms Front-End Processor (CFEP) computer once every hour.

TCEQ will decode and ingest data from the NOAAPort and ingest the data to LEADS. TCEQ will download the daily discharge look-up table from USGS and display discharge based on the table.

The USGS will be responsible for water quality through the point of data validation.

USGS will be responsible for detecting and resolving any communications issues with the monitoring sites up to and including the GOES transmission.

The site operator should check the operational status of the station every business day via the USGS website. If communication problems are detected, the site operator needs to initiate corrective action in a timely manner.

C1 ASSESSMENTS AND RESPONSE

Corrective Action

As described in the United States Geological Survey Techniques and Methods 1-D3, Guidelines and Standard Procedures for Continuous Water-Quality Monitors.

C2 REPORTS TO MANAGEMENT

The TCEQ CWQMN Network Coordinator must be notified in writing of any USGS collected data (only USGS validated data that has been provided to TCEQ) that has been identified by USGS and/or TCEQ as not meeting USGS/TCEQ quality objectives or criteria.

Reports to TCEQ Project Management

USGS will provide TCEQ with a report providing the following information when any USGS validated data does not meet quality objectives or criteria:

- Specific data not meeting quality objectives or criteria.
- The quality objective or criteria not met.
- An explanation of impact to data.
- Corrective action.

D1 DATA REVIEW, VERIFICATION, AND VALIDATION

As described in section D1 of the CWQMN QAPP.

D2 VERIFICATION AND VALIDATION METHODS

USGS is responsible for the validation of water quality and discharge data.

As described is section D1 of the CWQMN QAPP. USGS will validate (behind TCEQ's firewall) water quality data using LEADS manual validation tool. USGS will follow: TCEQ SOP DQRP-015 Validation of Continuous Water Quality Monitoring Data Collected by Multiparameter Sonde. (Attachment B)

When CVS criteria ($\leq$5.0% RPE) for SC are not met the corresponding calculated TDS values back to the last SC calibration should be invalidated using the AQI data flag (AQI Ambient Quality Invalidated).

D3 RECONCILIATION WITH DATA QUALITY OBJECTIVES

TCEQ Project Lead will make the determination if the data in question are usable.

Attachment A: TCEQ AMPM – 011 Analysis of Dissolved Oxygen (DO), Specific Conductance (SC), pH, Temperature, and Sample Depth in Ambient Surface Water Using Yellow Springs Instrument (YSI) 600 XLM and 6600 Extended Deployment System (EDS) Sondes

STANDARD OPERATING PROCEDURE (SOP)	
Title: Analysis of Dissolved Oxygen (DO), Specific Conductance (SC), pH, Temperature, and Sample Depth in Ambient Surface Water Using Yellow Springs Instrument (YSI) 600 XLM and 6600 Extended Deployment System (EDS) Sondes	
Team Leader: _____	Date: _____
Quality Control Review: _____	Date: _____
Section Manager: _____	Date: _____
Effective Date: 06/22/06	

1.0 PURPOSE

This describes the analytical procedures for continuous automated analysis of DO, SC, pH, Temperature, and Sample Depth in ambient surface water using the YSI 600 XLM and 6600 EDS Sonde (Multi-probes).

2.0 SCOPE AND APPLICABILITY

2.1 This procedure is intended for use in the Continuous Water Quality Monitoring Network (CWQMN).

2.2 Due to the extended length of time Sondes are deployed the data can be used to establish baseline conditions, identify trends, characterize pollution events, and seasonal variations in water quality.

2.3 SC, DO, pH, and Temperature data meeting Surface Water Quality Monitoring Data (SWQM) Quality Objectives Criteria (DQOs) may be used for the Federal Clean Water Act Sections 305(b) Report and 303(d) Lists.

2.4 Sonde sample depth measurements can be used for data validation purposes. The working ranges of the sensors are listed below.

Parameter	Working Range
DO	0 - 50 milligrams/Liter (mg/L)
SC	0 - 100,000 micro siemens/cubic centimeter (µS/cm)
pH	0 - 14 pH Units
Temperature	5° to 45° Degrees Celsius (°C)
Sample Depth	0 - 61 meters

3.0 METHOD SUMMARY

3.1 The Sonde is deployed in the water body of interest and ambient surface water DO, SC, pH and temperature is measured in situ. Membrane electrodes for DO analysis can be used in polluted waters, highly colored waters and strong waste effluents due to the oxygen-permeable plastic membrane that serves as a diffuse barrier against impurities.

3.2 The DO sensor is a polarographic membrane electrode, which has solid metal anode and cathode in contact with a supporting electrolyte separated from the test solution by a semi-permeable membrane. The membrane electrode is continuously polarized at a voltage to cause oxygen to be reduced to hydroxide ion at the cathode and silver metal to be oxidized to silver chloride at the anode. The oxygen diffuses through the membrane. The temperature compensated current associated with this process is proportional to the oxygen concentration in the test solution outside the membrane. The YSI electrode is polarized and depolarized during a measurement sequence resulting in a measured net charge that reduces oxygen consumption in the test solution.

3.3 The Electrical Conductivity (EC) sensor is a flow cell with four electrodes. Conductivity/specific resistance is measured through an approximately 5.0 centimeter^{-1} cell using alternating current.

3.4 The pH sensor utilizes a glass sensing electrode with a combined double junction half cell silver chloride reference electrode. The reference electrode provides a constant electrode potential and makes an electrical circuit with the sensing electrode. The sensing electrode contains a glass bulb of a fixed concentration of potassium chloride solution in contact with the reference electrode. Sodium ions are exchanged for hydrogen ions and a potential develops across the sensing membrane; the resulting membrane potential varies with pH. The reference electrode quantitatively compares the changes of the sensing membrane.

3.5 Surface water temperature is measured by a resistance thermistor.

3.6 Sample depth is measured by a non-vented pressure transducer. The transducer measures the pressure of the water column plus the atmospheric pressure above the water with a differential strain gauge.

4.0 LIMITATIONS

4.1 DO, EC, and pH sensors can become fouled due to bacteria, algae, and chemical deposits. In some water bodies (or due to seasonal variations in water quality) sensor fouling can occur rapidly, decreasing deployment periods. YSI 6600 EDS sondes are equipped with a brush that mechanically cleans the DO and pH sensor tips. This capability can increase deployment periods. Prolonged use of membrane

electrodes in waters containing such gases as hydrogen sulfide tend to lower cell sensitivity.

4.2 DO membrane electrode sensitivity vary with dissolved salt concentration. Plastic film membranes are permeable to a variety of gases besides oxygen. The acid electrolyte in the galvanic cell must be replaced periodically after its capacity to reduce oxygen is depleted. Ambient DO concentration measurements are not corrected for changes in local barometric pressure after calibration.

4.3 In rivers that have high sediment loading, sensors can periodically become covered with sediment.

4.4 Electrolytic conductivity increases with temperature. Significant errors can result from inaccurate temperature measurements.

4.5 The glass pH electrode is relatively free from interference from color, turbidity, colloidal matter, oxidants, reductants, or high salinity, except for sodium error at pH > 10. pH measurements are affected by temperature and can cause long term drift.

4.6 The depth sensor is non-vented. The software uses the atmospheric pressure at the time of calibration, changes in atmospheric pressure between calibrations appears as changes in depth. The error is equal to 0.045 feet for every 1 millimeter mercury (Hg) change in atmospheric pressure.

4.7 Expired standards should not be used.

5.0 SAFETY

This procedure includes processes that can be hazardous. Therefore, before attempting this process, review the TCEQ Chemical Hygiene Plan for proper equipment and procedures necessary for the safe completion of this procedure. Operators must read and be familiar with the Material Safety Data Sheets for potassium chloride. Lab coats, safety glasses with side shields and/or splash goggles and chemical resistant gloves should be worn when handling these chemicals. These chemicals have the potential to be skin and eye irritants.

6.0 EQUIPMENT AND REAGENTS

6.1 Equipment

- YSI 600 XLM or 6600 EDS, with EC, DO, pH, Temperature, and Depth Sensors
- YSI Multi-Parameter Display System (MDS)
- YSI Field cable
- Calibration forms

- Instrument logbook
- Calibration Cup
- Ring stand and clamp
- Plastic bucket large enough to immerse sonde sensors completely in water
- Thermistor or Thermometer traceable to National Institute of Standards and Technology (NIST) with a 0.1°C

6.2 Standards and Reagents (All reagents/chemicals must be AR grade)

- EC Potassium chloride (KCL) solution calibration standards traceable to NIST
- KCL solutions traceable to NIST with approximate pH values of 7.00 and 10.0 pH units in neutral-to-basic water bodies. In neutral to acidic waters approximate pH values of 4.00 and 7.00 pH units should be used
- De-ionized (DI) Type1 water

7.0 PROCEDURE

Before water quality is monitored, the sensors are calibrated and quality control (QC) samples are analyzed at a minimum of once a month. The station's water quality parameters are monitored by the site operator remotely to evaluate operational status of the station.

7.1 Monitoring

The Sonde measures ambient surface water while in situ. The Sondes can be deployed in poly vinyl chloride (PVC) tubing that is attached to a support structure.

7.1.1 The sonde should be deployed in a representative section of the water body. When monitoring rivers and streams, the sonde should be located as close as possible to the centroid of flow. Centroid is defined as the midpoint of that portion of stream or river width which contains 50 percent of the total flow.

7.1.2 Sensors should be at approximately one foot of water depth. Areas of excessive vegetation, turbulence, or silt should be avoided.

7.1.3 Drill holes in the PVC to allow for an exchange of water into the tubing.

7.1.4 Adjust the sonde periodically due to fluctuations in water levels of the water body.

7.2 Station Monitoring

The site operator should monitor water quality and other parameters daily to ensure the station is operational.

7.2.1 Every business day the site operator will monitor (via TCEQ website http://www.tceq.state.tx.us/compliance/monitoring/water/quality/data/wqm/swqm_realtime_alt.html/data) and screen EC, DO, pH, temperature, and sample depth measurements for anomalies. If problems are identified, a site visit may be needed to correct any problems.

7.2.2 Sample depth measurements can be used as an indicator to whether the sonde sensors are still submerged in the water body or that the sonde may need to be adjusted to the correct depth.

7.3 DO, EC, and pH Sensor Calibration Verification Samples (CVS) and Temperature QC.

EC, DO, and pH CVSs are analyzed and the sensors are re-calibrated at a minimum of once every month. More frequent sensor re-calibrations may be needed in high fouling environments. The site operator will need to determine sensor re-calibration frequency for their water body. Temperature and sample depth sensors are checked monthly. Note: The TCEQ Surface Water Quality Monitoring program has used the phrase "Post-Calibration" to describe QC samples used to assess analytical drift from previous sensor calibrations. For the purposes of this document, CVS is used in place of "Post-Calibration"

7.3.1 EC, DO, and, pH CVSs are analyzed at a minimum of once every month (or more frequently) immediately before the sonde EC, DO, and pH sensors are re-calibrated. If a EC, DO, or pH temperature does meet acceptance criteria in Table 9-1, the data for failing parameter(s) must be invalidated back to the last sensor CVS or calibration. For further details, see Section 9.0.

7.3.2 The temperature sensor should be checked once every month. If the sensor does meet acceptance criteria in Table 9-1, the temperature data must be invalidated back to the last temperature check. For further details, see Section 9.0.

7.3.3 The depth sensor should be calibrated once every month.

7.3.4 If barometric pressure for DO calibrations is determined using the barometer in the YSI Multi-Parameter Display System (MDS) the accuracy of the barometer will need to be checked once a year.

7.4 EC, DO, pH, and Depth Sensor Calibration

EC, DO, pH and Depth Sensor calibrations are performed once a month at a minimum and are performed immediately after the monthly EC, DO, and pH CVSs are analyzed. After EC, DO, pH, and depth sensor calibration(s), calibration parameters/constants are recorded in the instrument logbook. When using the YSI MDS to obtain barometric pressure for DO calibrations the MDS barometric pressure sensor is checked once a year.

- Note: Perform calibrations and analyze DO, EC, and pH CVSs as close to 25.0 °C as possible.
- Note: perform the EC calibration before calibration of the pH sensor.
- Barometric pressure measurements for DO calibrations can be obtained at the National Weather Service.
- Allow the sonde and calibration standards time to equilibrate before calibration(s) or initial readings.
- Use a ring stand and clamp to secure the sonde body.
- Before calibration, make sure plugs are installed in empty sensor ports.
- Insure all sensors are immersed in KCL calibration solutions.
- Use a small amount of calibration solution to pre-rinse the sensors. Old calibration solutions may be used for this.
- Have several clean absorbent paper towels. Shake the excess rinse water off the sondes. This will reduce carry-over contamination of calibrator solutions.

7.4.1 Single-Point EC Calibration

The calibration of the EC sensor consists of a single-point calibration with a KCL solution. Choose the calibration conductivity that is closest to the expected conductivity of the water body. During the calibration, the YSI sonde will measure the temperature of the standard and automatically calculate the (non-normalized) conductivity of the standard.

- Rinse the sensor twice with conductivity standard.
- Fill the calibration cup with conductivity standard. Place the sensors into the conductivity standard and make sure the sensors are completely immersed passed the vent hole. Allow at least 60 seconds for the temperature to equilibrate. After EC readings have stabilized record temperature and initial specific conductance measurement of the standard before calibration on the calibration worksheet.
- Gently tap the side of the calibration cup to dislodge any air bubbles from the cell.
- Allow at least one minute for temperature equilibration to occur before proceeding with the calibration.

- From the Calibration Menu select 1-Conductivity and a second menu will offer you options of calibrating in specific conductance, conductivity, or salinity. Calibrating any one option automatically calibrates the other two.
- Select Specific Conductance and then you will be prompted to enter the value of the EC standard (µS/cm or ms/cm at 25.0° C). Then select Enter
- Observe readings under Specific Conductance or Conductivity, and when they show no significant change for approximately 30 seconds, press Enter. The screen will indicate that the calibration has been accepted; press Enter again and return to the Calibrate menu.
- Record EC calibration constant on the Calibration Worksheet. The EC Cell Constant should be between 4.5 and 5.5. Values outside the recommended range may indicate the EC sensor needs maintenance or replacement.

7.4.2 Two-Point pH Calibration

The pH calibration requires two KCL solutions (pH 4.00 and 7.00 or pH 7.00 and 10.00). Choose solutions that bracket the expected pH range of the water body.

- Place enough pH 7.00 buffer into a clean, dry, or pre-rinsed calibration cup to immerse the pH probe reference junction, and thermistor. Allow one minute for the temperature to equilibrate.
- From the Calibrate menu, select 4-ISE1 pH to access the pH calibration choices; then select 2 point. Press "Enter" and input the value of the buffer at the prompt. Press Enter and the current values of the enabled sensors will appear on the screen. Observe the pH millivolt (mV) readings. This value should be between -40 and 40. Record the mV on the calibration worksheet.
- Observe the pH reading and when it shows no significant change for approximately 30 seconds press Enter. The display will indicate that the calibration is accepted.
- After the pH 7.00 calibration is complete, press Enter to continue. Rinse the sonde with water before proceeding.
- Place enough pH 4.00 or 10.00 buffer solution into a clean, dry, or pre-rinsed calibration cup to immerse the pH probe reference junction, and thermistor. Allow one minute for the temperature to equilibrate.
- Observe the pH mV reading. This value should be between 120 and 200 mV in pH buffer 4.00 and should be between -120 and -200 mV in pH buffer 10.00. Record the mV on the Calibration Worksheet. Values outside the range may indicate the pH sensor needs maintenance or replacement.

- Press Enter and input the value of the second pH buffer at the prompt. Select Enter and the current values of all enabled sensors will appear on the screen.
- Observe the pH reading and when it shows no significant change for approximately 30 seconds press Enter. The display will indicate that the calibration is accepted. After the second calibration is completed, press Enter again. If you are performing a 2-point Calibration, the display will return to the Calibrate Menu.
- After the calibration is complete, rinse the sonde with DI water before proceeding. Rinse the calibration cup.

7.4.3 DO Calibration

The DO sensor is calibrated using percent saturation in water-saturated air. When using YSI sondes in the CWQMN the Autosleep RS232 function should be enabled.

- From the Main Menu, Select 8-Advanced and then 2-Setup. Ensure that 5-Autosleep RS232 and 6-autoSleep SDI12 are enabled. If the Autosleep functions are not enabled, Select 5-Autosleep RS232 and 6-autoSleep SDI12 and press "Enter."
- Place about 1/8 inch water in the bottom of the calibration cup. Place the probe in the cup. Make certain that the DO and temperature probes are not immersed in the water. Engage only one thread of the calibration cup to ensure the DO probe is vented to atmospheric pressure. Wait at least 10 minutes for the air in the calibration cup to become water saturated and for the temperature to equilibrate.
- From the Calibrate Menu, Select 2-Dissolved Oxygen, then 1-DO% to access the DO% saturation calibration procedure.
- Follow the screen prompt and enter actual barometric pressure in mm of Hg, press "Enter," and the calibration will automatically occur after the warm-up time. Then, press "Enter" to return to the Calibrate Menu. Note: When using National Weather Service barometric pressure measurements, the reading will need to be uncorrected from sea level to actual barometric pressure. See equation in Section 8.1. YSI MDS barometric pressure sensor displays actual barometric pressure.
- Record the DO Charge on the Calibration Worksheet. This value should be between 25 - 75. Values outside the recommended range may indicate the DO sensor needs maintenance or replacement.
- Record the DO gain on the Calibration Worksheet. This value should be between 0.7- 1.7. If values are outside this range there could be calibration process errors(s) or calibration standard problems.
- Press "Enter" to return to the Calibrate Menu.

7.4.4 Depth Sensor Calibration

The depth sensor is non-vented. The depth sensor is factory calibrated, but it is always necessary to zero the absolute sensor relative to the local barometric pressure. Note: When performing a depth sensor calibration the sondes orientation should remain constant while taking readings.

- From the Calibration Menu, Select 3-Pressure Abs (non-vented) to zero the depth sensor.
- The zeroing procedure should be performed in ambient air. Select "depth option."
- After the depth option is selected, enter 0.00 at the prompt, press "Enter" and monitor the stabilization of the depth readings. After no changes occur for approximately 30 seconds, press "Enter" to confirm the calibration.
- As instructed, press "Enter" again to return to the Calibration Menu.

8.0 CALCULATIONS

8.1 Sea Level Corrected Barometric Pressure Uncorrected to Actual Barometric Pressure

This equation is used to uncorrected sea level corrected barometric to actual barometric pressure. Local barometric pressure obtained from the National Weather Service is corrected to sea level and is usually reported in inches of Hg (inches Hg x 25.4 = mm Hg).

$$ABP = CBP - (2.5mmHg)\left(\frac{A}{100}\right)$$

Where:

ABP = Actual Barometric Pressure in mm Hg.

CBP = Barometric Pressure corrected to see level in mm Hg.

A = is local altitude in feet above mean sea level.

2.5 mm Hg = constant.

8.2 Sample Conductivity

Electrical Conductivity is reported as SC using Equation 8.2.1.

8.2.1 SC is actual conductivity corrected to 25 °C:

$$SC = \frac{AC}{1 + 0.0191 \times (t - 25.0)}$$

Where:

AC = is non standardized conductivity in □S/cm.
t = is the solution temperature in degrees C.

8.3.1 To determine un-normalized (raw) potassium chloride EC concentration from normalized

Raw EC = normalized EC in µS/cm (1+0.0191(temp measured - 25)).

8.4 QC Calculations

8.4.1 The mean ($\overline{X}$) is the average of a given set of related data:

$$\overline{X} = \frac{\sum_{y=1}^{n} X_y}{n}$$

Where:

X = individual measurements; and
n = total number of measurements.

8.4.2 Relative Percent Error (RPE) can also be used to determine the relative accuracy of a measurement to a known value:

$$RPE = \frac{|Y - X|}{X} X100$$

Where:

Y = measured value; and
X = known value.

9.0 QC

9.1 QC Samples

Note: Analyze EC, DO, and pH CVSs as close to 25.0° C as possible.

QC samples are used to ensure that acceptable data quality is maintained throughout the process and to help assess data validation. The QC samples analyzed for this method are performed on a monthly basis, or more frequently as determined by the site operator.

Any deviation from the procedures documented in the SOP, including any QC samples which do not meet the frequency requirement or acceptance criteria, need to be documented in the operators log. The log entry should contain a description of the exception, the cause (if possible), the affected data, and the impact on data. Any affected data should be qualified accordingly. Note: A failing CVS can be followed by a single replicate analysis to determine if there is a systematic problem. If the reanalysis meets all acceptance criteria, then the system may be deemed as providing acceptable data. Conducting multiple analyses to obtain a single passing QC sample when no corrective action as a result of an assignable cause or instrument maintenance is performed is not acceptable. In other words, if the original QC sample or its rerun passes, then the failing QC analysis are considered to be an anomaly, its results are not used for data assessment.

EC QC Samples

9.1.1 An EC CVS is analyzed at a minimum of once monthly (before calibration of the EC sensor) to assess analytical drift from the previous calibration. The CVS should be the same standard used to generate the initial single-point calibration.

9.1.2 The CVS KCL solution is introduced using the Cal Cup. Rinse the sensor with DI water and shake off DI water before introducing the CVS. The Relative Percent Error (RPE) of the CVS should be 5.0 %. If the CVS does not meet acceptance criteria, the previous month's EC (back to the last EC calibration) data should be invalidated. Note: a failing CVS could be the result of an aged EC CVS standard. If CVS has failed, re-analyze the CVS using a fresh EC standard. CVS results should be entered into the operator log and Instrument Logbook.

DO QC Samples

The amount of DO in a sample is pressure and temperature dependent.

9.1.3 A DO CVS is analyzed a minimum of once monthly (before calibration of the DO sensor) to assess analytical drift from the previous calibration. The CVS consists of water percent saturation in water-saturated air using procedures in Section 7.4.3. Note: when using Section 7.4.3 the unit calibration step is not performed.

9.1.4 This reading (CVS) should be within 6.0% saturation.

9.1.5 If the CVS does not meet acceptance criteria the previous month's DO (back to the last passing CVS or DO calibration) data should be invalidated. CVS results should be entered into the operator log. The results should also be logged in the Instrument Logbook and/or recorded in the Calibration Worksheet.

pH QC samples

9.1.6 A pH CVS is analyzed a minimum of once monthly (before calibration of the pH sensor) to assess analytical drift from the previous calibration. The CVS consists of KCL solution of 4.00 or 10.00 pH units. The KCL solution is introduced using the Calibration cup. Note: Rinse the sensor with DI water and shake off DI water before introducing the CVS. The CVS is prepared from the same standard used to generate the initial calibration curve. The CVS should be within 0.50 pH units. Note: a failing CVS could be the result of an aged pH CVS standard. If CVS has failed re-analyze the CVS using a fresh EC standard. If the CVS does not meet acceptance criteria, the previous month's pH (back to the last pH calibration) data should be invalidated. CVS results should be entered into the operator log. The results should also be logged in the instrument logbook and/or recorded in the Calibration Worksheet.

Temperature

9.1.7 Once a month check the accuracy of sonde temperature sensor with a NIST traceable thermometer or thermistor. Fill a plastic bucket with water from the water body and immerse Sonde sensors into water. Place the thermometer or thermistor thermocouple next to the sonde temperature sensor and allow both temperature measuring devices time to stabilize. The Sonde temperature measurement should be within 1.5 °C of the NIST traceable thermometer or thermistor. If sonde temperature accuracy is not within acceptance criteria confirm with second NIST traceable thermometer or thermistor. If the sonde temperature is not within acceptance criteria with second NIST traceable thermometer or thermistor the previous (back to last temperature check) month's temperature data should be invalidated. If it is determined that the sonde's temperature sensor does not meet acceptance criteria, the sensor needs to be sent back

to the factory for repairs/calibration. The temperature check results should be entered into the operator log. The results should also be logged in the instrument logbook and/or recorded in the Calibration Worksheet.

YSI MDS Barometer

9.1.8 Once a year check the accuracy of the YSI MDS barometer using National Weather Service barometric pressure readings or use readings from a high quality laboratory barometer. The YSI MDS should be within 20 millimeters of Hg from the National Weather Service reading or a high quality laboratory barometer reading. See the equation in Section 8.1 to calculate National Weather Service sea level corrected barometric pressure to actual barometric pressure. YSI MDS and laboratory barometers measure actual barometric pressure. The barometer check results should be logged in the instrument logbook and/or recorded on the Calibration Worksheet.

Table 9-1

QC Checks

QC Check	Purpose	Frequency	Acceptance Criteria	Response Action
Single-Point EC Calibration	To establish slope used for quantitation	A minimum of once monthly or after failing CVS	Concentration level is detected	1) Analyze standard again 2) Perform corrective action as necessary 3) Re-calibrate
Single-Point DO Calibration	To establish slope used for quantitation	A minimum of once monthly or after failing CVS	Concentration level is detected	1) Analyze standard again 2) Perform corrective action as necessary 3) Re-calibrate
Two-Point pH Calibration	To establish slope used for quantitation	A minimum of once monthly or after failing CVS	Concentration level is detected	1) Analyze standard again 2) Perform corrective action as necessary 3) Re-calibrate
DO CVS (percent saturation in water-saturated air)	To assess sensor drift	Before sensor re-calibration. A minimum of once a month	± 6.0% saturation	1) Reanalyze CVS 2) If still failing perform corrective action and/or re-calibrate 3) Invalidate data accordingly
EC CVS	To assess sensor drift	Before sensor re-calibration. A minimum of once a month	≤ 5.0% RPE	1) Reanalyze CVS with fresh standard 2) Perform corrective action as necessary 3) Invalidate data accordingly
YSI MDS Barometric Pressure sensor	To assess sensor accuracy	Once a year and after sensor replacement	± 20 mmHg	Re-calibrate sensor

10.0 DEFINITIONS

See Appendix A of the Laboratory and Mobile Monitoring Quality Manual
Surface Water Quality Monitoring Quality Assurance Project Plan

11.0 REFERENCES

U.S. EPA equivalent method EQSA-0193-092
U.S. Geological Survey TWRI Book 9
Yellow Springs Instrument 6-series Operator's Manual
TCEQ Operating Policies and Procedures, Chapter 6.13
Laboratory and Mobile Monitoring Quality Manual
Surface Water Quality Monitoring procedures Manual, Volume I
Continuous Water Quality Monitoring Network Quality Assurance Project Plan
Monitoring Operations Hazardous Waste Disposal Plan
TCEQ Chemical Hygiene Plan

12.0 POLLUTION PREVENTION AND WASTE MANAGEMENT

Supervisors, sampling personnel, and laboratory analysts should identify and implement innovative and cost-saving waste reduction procedures as part of the method development, review, and revision of standard operating procedures. Wastes that do result from these procedures are managed and disposed of in accordance with appropriate state and federal regulations.

Refer to Chapter 6.13 of the TCEQ Operating Policies and Procedures for guidelines on general recycling, waste reduction, and water and energy conservation. Review these procedures for specific employee responsibilities and mechanisms for office-related waste prevention and management. Consult the Monitoring Operations Hazardous Waste Disposal Plan for laboratory-specific waste minimization recommendations and requirements for proper handling of hazardous waste that result from laboratory procedures.

The reagents, washes, standards, and waste associated with this procedure do not require special disposal. Before disposing waste into a municipal sewer system check with respective municipal sewer system on what concentration levels are allowed to be put into their system.

13.0 SHORTHAND PROCEDURE

- Set-up Procedures (Section 7.1 and, 7.3).
- Calibrate EC, DO, pH, and Depth Sensors once a month at a minimum.
- Deploy sonde.
- Monitoring and Sensor Verification (Section 7.2 and 7.4).
- Monitor sonde every business day via the internet.
- Analyze EC, DO, and pH CVSs once a month.
- Check sonde temperature and depth sensors monthly.
- Check YSI MDS barometric pressure sensor yearly.

Attachment A

YSI SERIES 6 SONDE (MULTI-PROBE) CALIBRATION WORKSHEET FOR USE IN CONTINUOUS WATER QUALITY MONITORING NETWORK					
Calibration					
Date: Time:		Analyst: YSI MDS serial number:			
Battery Voltage:		Sonde Type and Serial No.			
CAMS Station:		Location:			
Date Deployed:		Date Retrieved:			
Parameter	Temp. of Standard	Concentration or pH of Calibration Standard	Initial Reading	Calibrated to	Comments
Specific conductance (high) 1,000 µmhos/cm					
Conductivity cell constant					Range 4.5 to 5.5
pH calibrated (~7)					
pH mV for pH 7 solution					Range 0 ± 40 mV
pH slope (~ 4/10)					
pH mV for pH 10 pH mV for pH 4					Range: -160 ± 40 mV Range: +160 ± 40 mV
Dissolved oxygen (%sat)					
Dissolved oxygen charge					Range 25 to 75
Dissolved oxygen gain					Range 0.7 to 1.7
Barometric pressure (actual) used for DO calibration _____mm Hg					

Attachment A (continued)

Barometric Pressure (BP) Options	Barometric Pressure Formulas
Altitude (A) =_____feet above mean sea level	
National Weather Service Barometric Pressure corrected to sea level in inches of Hg.	Barometric pressure (inches) _____ x 25.4 = BP _____mm Hg
	Actual BP = corrected BP _____mm - 2.5 (altitude ____/100)

Deployment Checklist	
Logging interval: Yes No	SDI-12 Autosleep enabled: Yes No
DO warm-up time:	Battery volts in Sonde (days):
RS 232 autosleep enabled: Yes No	Available memory in Sonde (days):

Calibration Verification Sample (CVS), Post-Calibration				
Date:	Time:	Analyst:	Fluke Thermometer Serial No.	
Battery Voltage:		Sonde Type and Serial No.		
Parameter	Temp. of Standard	CVS Concentration or pH	CVS or temp results	Criteria
Specific conductance				. 5.0% RPE
pH calibrated (~7)				. 0.50 pH unit
YSI SERIES 6 SONDE (MULTI-PROBE) CALIBRATION WORKSHEET FOR USE IN CONTINUOUS WATER QUALITY MONITORING NETWORK				
pH slope (~ 4/10)				. 0.50 pH unit
Dissolved oxygen				. 6.0% saturation
Temperature	NA	NA		. 1.5 degrees C

Comments:

YSI Multi-Parameter Display System (MDS) Barometer Worksheet

Date:

Analyst:

YSI MDS serial number:

Reference standard: National Weather Service or Laboratory Barometer

Attachment A (continued)

Parameter	MDS Barometric Pressure (mm Hg)	Reference Standard Barometer Pressure (mm Hg)	Criteria
YSI MDS Barometer			20 mmHg

Comments:

Attachment B Validation of Continuous Water Quality Monitoring Data Collected by Multiparameter Sonde

STANDARD OPERATING PROCEDURE (SOP)	
Title: Validation of Continuous Water Quality Monitoring Data Collected by Multiparameter Sonde	
Team Leader: _____	Date: _____
Quality Control Review: _____	Date: _____
Section Manager: _____	Date: _____
Effective Date: 4/14/06	

1.0 PURPOSE

This SOP describes the procedure for Level I validation of ambient water quality data acquired from continuous water quality monitoring stations located within selected river basins of the State of Texas utilizing existing infrastructure and Leading Environmental Analysis and Display System (LEADS) data processing software.

2.0 SCOPE AND APPLICABILITY

Continuous water quality monitoring data for validation may include, but are not limited to: temperature, pH, dissolved oxygen, specific conductivity, turbidity, nitrate, ortho-phosphorus, and ammonia. The automated procedures are performed by the LEADS computer system, and the manual procedures are performed by the Water Data Validator.

3.0 METHOD OR PROCEDURAL SUMMARY

Data is examined for record completeness and reporting accuracy. Operator logs are reviewed for calibration and post-calibration records and unusual events. Data losses are investigated and data values exceeding established critical limits (Appendix A) are flagged or invalidated.

4.0 LIMITATIONS

4.1 Data validation is dependent upon the quality of field observations and reported calibration information in the Operator Log.

4.2 If data is reloaded or reprocessed after validation, previously flagged and/or recovered data defaults to the original status. Data must be validated again by referring to the Validator's Log and operator logs.

4.3 LEADS is a developing system. The software tools used to validate data may contain

defects that may or may not be identified. This may necessitate checking one tool against another.

4.4 This procedure does not include Level II data validation with the SAS Program.

5.0 SAFETY

Usual office and computer safety practices apply. For additional information about the TCEQ safety program, see: http://home.tnrcc.state.tx.us/internal/admin/support/safety/index.html.

6.0 EQUIPMENT

Computer Hardware

- 486PC, 8MB RAM, 80 MB hard-drive or 68040 Macintosh, 8MB RAM 80 MB hard-drive
- Data logger, data communication hardware
- SCO UNIX computer system, 16 MB RAM, 500 MB hard-drive
- Modems (118)
- Central office HP Computer K460
- Ethernet Connection
- Seaspace Satellite System (images)

LEADS Hardware

Processor	Name	Type
Central Processor	tnrcc3	HP K460
Validation	tnrcc1	HP D380
Web Server/Validation	dsr	HP J280
Validation/Weather	tnrcc5	HP 715
Validation/Weather	tnrcc6	HP 715
Satellite	tnrcc4	HP 735
Satellite	tnrccs	HP D390
Comms Front End	cfep	HP C110
Test Bed	tnrcc9	HP 735
Sys Admin	tiros	HP 712
Weather	wx	HP 712
Amarillo Hub	reg1	HP 712
Arlington Hub	reg4	HP 712
Tyler Hub	reg5	HP 712
El Paso Hub	reg6	HP 712
Midland Hub	reg7	HP 712
Beaumont Hub	reg10	HP 712
Austin Hub	reg11	HP 712
Houston Hub	reg12	HP 712
San Antonio Hub	reg13	HP 712
Corpus Christi Hub	reg14	HP 712

Harlingen Hub	reg15	HP 712

Data logger, data communication hardware

- SCO UNIX computer system, 16 MB RAM, 500 MB hard-drive
- Modems (118)
- Central office HP Computer K460
- Ethernet Connection
- Seaspace Satellite System (images)

Computer Software (Validation Tools)

- HP UNIX
- SCO UNIX
- HP View Light, View, CDE (Common Desktop Environment)
- Exceed for PC
- Exodus for Macintosh
- LEADS pollution user interface
- LEADS user interface
- Microsoft Excel menu
- Microsoft Word
- Netscape
- Labview/Zeno datalogger application
- WXPlot
- AQPlot
- Power Point
- Fetch
- WXBase
- Fox Pro

7.0 PROCEDURE(S)

7.1 Daily procedure

7.1.1 Verify the operation of the *in-situ* multi-parameter data sonde, the ZENO data logger, and completed data transmission in the morning and at close of business, at a minimum.

- Using an internet browser, access the Texas Commission on Environmental Quality (TCEQ) internal server at **http://dsr/**. Within the **Data Reporting Pages** section, view the *CAMS Hourly Averages by Site* or *CAMS Data Printout*. Select the date, time format, CAMS number/location of the real-time water site, and generate a report. Confirm the data retrieval for all parameters.

- If data is missing, access *Comms Report* within **the Status Pages** section to confirm communication between the remote sites and the central computer site.

- Access the *Operator Logs* to check for unscheduled maintenance or unusual events.

- Contact the site operators and the project lead for possible site investigation/repairs, if necessary.

- Contact the LEADS administrator for possible data recovery and/or to resolve communications problems.

7.2 Weekly Procedure

7.2.1 Using an internet browser, access the TCEQ internal server at **http://dsr/**. Within the **Status Pages** Section, review the *Operator Logs* for each site to be validated. Confirm reporting of preventative maintenance information and calibration/post-calibration data for the previous seven days.

7.2.2 Access the LEADS Pollution Interface via an x-terminal emulation package (Exceed). Contact the LEADS Administrator for access rights, validation rights, and passwords.

7.2.3 Access the Manual Validation Retrieve window via Manual Validation Login.

- Select the "Start Time" button and indicate the beginning month, day, and time of the data validation interval.

- Select the "End Time" button and indicate the end month, day, and time of the data validation interval.

- Select the appropriate time label.

- Select the "Five-Minute" Database.

- Select sort by "CAMS."

- Select "Show Sites."

- Highlight the CAMS site for validation from the site list.

- Select "Show Available."

- Highlight the validation parameters. Hold down the CTRL key to select up to four validation parameters at one time.

- Select "OK."

- Compare the automatically generated LEADS data flags with the Operator Logs. Edit any data flagged incorrectly by selecting the data interval in the Manual Validation window and selecting the appropriate data flag from the EDIT drop-down menu. Document any changes in the Validator's Log. See Appendices A and B for data flags and flag priorities.

- If the Operator Log indicates that a parameter failed post calibration, flag the data associated with that parameter for the corresponding time period as invalid with an AQI flag. If PMA flags have been automatically generated, the data for the subsequent hour is flagged AQI.

- Investigate irregular data patterns by referring to the Operator Log, contacting the site operator for further information, using Best Professional Judgment (BPJ), and/or notifying the Surface Water Quality Monitoring (SWQM) staff.

- After all data flagging is complete, choose "Validate Data" from the FILE drop-down menu. Note any changes made to the data during manual validation in the Manual Validation Notes window. Include detailed explanation for any changes. Initial all entries. Ensure all changes are documented in the Validator's Log.

- Select the "Validate" button on the Manual Validation Notes Page to complete the validation procedure.

8.0 CALCULATIONS

Not Applicable

9.0 QUALITY CONTROL

9.1 Each experienced data validator is responsible for review, validation, and verification of data from assigned ambient stations.

9.2 Maintain detailed records in the form of a hardcopy Validator's Log that includes all activities and follow-up actions relating to ambient data. The records should be sufficient to reconstruct the data validation event.

9.3 The data validator reviews and questions any part of the measurement process and initiates data reviews and corrective actions to bring the process back into compliance.

9.4 The data validator uses a supplemental tool to examine water quality data. The data is reviewed using a SAS Program that can graph more of the data record than LEADS, and allows easy manipulation of scale. This Level II data validation ensures that data anomalies that are not apparent in LEADS are discovered and data is qualified accordingly.

10.0 DEFINITIONS

AQI – Ambient Quality Invalid
BPJ – Best Professional Judgment
CAMS - Continuous Ambient Monitoring Stations
EMS - Environmental Monitoring System
LEADS - Leading Environmental Analysis and Display System
PMA – Preventive Maintenance Action
SWQM - Surface Water Quality Monitoring
TCEQ – Texas Commission on Environmental Quality

11.0 REFERENCES

LEADS Web pages. Training Material: Manual Validation

LEADS Operator's Manual

TCEQ Operating Policies and Procedures, Chapter 6.13

Monitoring Operations Hazardous Waste Disposal Plan

12.0 POLLUTION PREVENTION AND WASTE MANAGEMENT

Supervisors, sampling personnel, and laboratory analysts should identify and implement innovative and cost-saving waste reduction procedures as part of the method development, and review and revision of standard operating procedures. Wastes that do result from these procedures are managed and disposed in accordance with appropriate state and federal regulations.

Refer to Chapter 6.13 of the TCEQ Operating Policies and Procedures for guidelines on general recycling, waste reduction, and water and energy conservation. Review these procedures for specific employee responsibilities and mechanisms for office related waste prevention and management. Consult the *Monitoring Operations Hazardous Waste Disposal Plan* for laboratory specific waste minimization recommendations and requirements for proper handling of hazardous waste that results from laboratory procedures.

13.0 SHORTHAND PROCEDURE

13.1 Daily

- Confirm the collection and transmission of data.
- Contact the LEADS administrator for recovery of lost data, if necessary.
- Contact area operators and the project lead for site investigations, if necessary.

13.2 Weekly

- Investigate any irregular data patterns.
- Confirm all data flags.
- Edit any incorrect data flags.
- Document any data changes in the Validator's Log.
- Validate data.

Appendix A

Flags used by MeteoStar/LEADS

If there are less than nine valid five-minute samples within an hour, consult the priorities to determine which flag to assign to the hourly average. Flags with higher priorities overwrite flags of lower priority.

Flag	Description	Manually Set	Automatic	Priority
LST	Lost or missing data - indicates that data for this sample period is not stored in the MeteoStar database		X	1
LIM	Data failed one or more automatic quality checks		X	5
PMA	Instrument in preventative maintenance mode	X (set by field operators)		6
AQI	Data invalid	X		12
FEW	Not enough samples to create an hourly average		X	4
NEG	Data failed NEG test indicates data values are too negative; normally low negative values are set to zero by the MeteoStar software		X	3
VAL	Data valid	X	X	0

Validator Alert Limits

These limits are established to alert the water data validator to values exceeding the water quality standard and/or the expected normal range as determined by historical data for each site.

Green Creek at CR 266 and Resley Creek at CR 394		
Parameter	**Lower Limit**	**Upper Limit**
Temperature (°C)	< 1.00	> 33.00
pH	< 5.00	> 9.00
Dissolved Oxygen (mg/l)	0.00 to -0.50** < -0.51	> 16.00
Specific Conductivity (μmhos/cm)	< 163	> 1260
Turbidity (NTU)*	0	1000

North Bosque River on Riverside Road in Clifton and Leon River at Fauntleroy Park in Gatesville		
Parameter	**Lower Limit**	**Upper Limit**
Temperature (°C)	< 1.00	> 33.00
pH	< 5.00	> 9.00
Dissolved Oxygen (mg/l)	0.00 to -0.50** < -0.51	> 16.00
Specific Conductivity (μmhos/cm)	N. Bosque River < 146 Leon River < 181	> 938 > 1428
Turbidity (NTU)*	0	1000

* Limits based upon instrument range rather than actual historical data due to short term environmental effects.
**Generates an automatic NEG flag.
°C - degrees Centigrade
mg/l - milligrams per liter
μmhos/cm - micromho